

## **Report on Survey A8-2007 – Arni Friðriksson, TFNA**

### **Pelagic fish off W- S- and SE-Iceland and the western Norwegian Sea 03 - 30 May**

*Part of the joint Northeast Atlantic Pelagic Ecosystem Surveys in 2007  
(see ICES PGNAPES report, August 2006)*

#### ***General information***

Vessel: R/V Arni Fridriksson, TFNA (Iceland)

Captain: Guðmundur Bjarnason

#### *Scientific staff:*

##### *3-16 May*

Sveinn Sveinbjörnsson, cruise leader, acoustics

Björn Sigurdarson, acoustics, cartography, technology

Jóhann Gíslason, biological trawl samples

Einar Hreinsson, capturing pelagic trawl fishery on film

Haraldur Einarsson, capturing pelagic trawl fishery on film

Karl S. Helgason, capturing pelagic trawl fishery on film

Guðmundur Gunnarsson, capturing pelagic trawl fishery on film

Fróði Skúvdal, capturing pelagic trawl fishery on film

##### *16-30 May*

Guðmundur J. Óskarsson, cruise leader, acoustics

Hjalmar Vilhjalmsen, acoustics

Björn Sigurdarson, acoustics, cartography, technology

Ragnhildur Ólafsdóttir, biological trawl samples, aging of herring

Leifur Adalsteinsson, biological trawl samples

Gerður Palsdóttir, plankton

Agnar M. Sigurðsson, plankton, ageing of blue whiting

#### ***Survey description***

In order to assess blue whiting concentrations west and south of Iceland, the survey began on 3 May at the shelf edge west of Iceland, just south of the Dohrn Bank and from there continued south at and on either side of the shelf break to the Reykjanes Ridge.

South of the Reykjanes promontory (SW-Iceland) the general course was eastwards, running along and just off and in over the outer shelf. From SE-Iceland the area between Iceland and Faroe Island was covered or the area from 62°30'N to 64°35'N, between approximately 09°00'W and 12°-13°W, i.e. blue whiting concentrations inside the Icelandic and the western Faroese EEZs.

Having completed the blue whiting part of the survey, on 15 May, the vessel sailed to Torshavn in the Faeroe Island for substitute some of the crew and scientist members onboard and to take on fuel, water and other provisions.

On 16 May, surveying was resumed at 64°40'N-08°00'W and during the following days continued northwards along E/W transects spaced at about 30 n.m. intervals but 40 n.m. intervals north of 66°10'N. The western boundary was generally about 12°W, i.e. the survey went well into the cold waters of the East Icelandic Current. The eastern limits were generally around 06°W but increased to 04°W at 68°48'N.

The final CTD and WP-2 station was taken on 27 May at 69°40'N and 10°50'W, where the vessel headed then along the north coast of Iceland to Reykjavik and was in harbour on 30 May.

## ***Materials and methods***

### ***Survey design***

The survey design was of two types. First, when assessing blue whiting west and south of Iceland, a zig-zag course was adopted as in these waters the target fish almost always occur in a narrow strip near the shelf edge. By running diagonally in and out of the recordings this type of survey setup gives a longer time among blue whiting recordings and thus better coverage in addition to be less time consuming. When coming east to the southwestern Norwegian Sea the survey design was changed to parallel E/W courses spaced at about 30 n.m. but was increased to 40 n.m. as the quantity of herring diminished. This was according to the predetermined plan and is a better way of surveying an open ocean where fish distribution can be assumed to be random rather than following any predetermined course.

### ***Equipment and sampling***

Acoustic scatters were recorded continuously by a Simrad EK500 echo sounder and post-processed using a BI 500 integrator with a plankton sieve threshold of -70dB. The remaining echoes were then stored in their respective categories (mainly herring and blue whiting) as 1 mile averages and averaged again over every 5 miles. In order to get an idea of how well herring densities were represented by the echo sounder, Kaijo Denki low and high frequency sonar were run continuously throughout the survey. However, formal school counts were not made.

Sea temperature and salinity were measured from surface to bottom using a SeaBird CTD. At bottom depths greater than 1000 m, recordings were stopped at that depth. Inter-station distance was generally in the range of 25-45 n.m. A total of 47 CTD stations were carried out during the cruise.

A WP2 net was used to quantify zooplankton volume at each CTD location except for the first 11 stations and 2 stations later on when the wind was too strong for the sampling gear. Two vertical hauls were made at each station, i.e. from 50 m and 200 m to the surface at total 35 stations. On every third station, an additional 50 m haul was made.

Acoustic records were sampled fairly regularly by two types of pelagic trawls, both produced by Hampidjan, Iceland. These were a Gloria 1024 and Gloria 1907, a wide opening trawl. As usual, the decision to sample was taken by the acoustic watch on the basis of changes of the echo recordings or simply because of the length of time elapsed since the last haul. A total of 42 hauls were made. The fishing gear worked well and there were few empty hauls.

The total catch per species and the treatment of the samples is given in Table 1.

Beside the main object of the survey to map and measure the distribution of blue whiting and herring, the pelagic trawl fishery was captured on film in the first part of the survey. The objective of the filming was to explore the performance of sorting grid in front of codend and the behaviour of pelagic fish against it. The results of this project are neither given nor discussed in this report.

## ***Results***

### ***Hydrography***

Like in the last few years both temperature and salinity were above average in the warm Atlantic water south and west off Iceland (temperature ranging from 6°- 9°C and salinity 35,1 - 35,3) according to the spring survey on RV Bjarni Sæmundsson in May 2007. In the upper water masses off the north coast, the temperature was near the long-term mean but the salinity was below the mean. The salinity in the East-Iceland Current north-east off the Icelandic shelf was just above long-term mean while the temperature was near the mean. Finally, the conditions in the upper water masses on the shelf off the east coast were around and just below the long-term mean, which means colder and fresher water than in the most recent years.

Location of waters of the East Icelandic Current was similar to the last two years or in fairly large areas northeast and east of Iceland and reached south to about 65°N with an eastern border between about 7° and 08°W (Figure 1). However, north of 68°3N the Atlantic water reached further west than in previous years or to around 9°N. The condition in the eastern Norwegian Sea seemed to be near average.

The cruise transects are shown on Figure 3 (off W and S Iceland) and Figure 4 (E off Iceland), while the location of CTD and WP2 stations are shown on Figure 1 along with the temperature at different depths.

### ***Zooplankton***

According to the annual spring survey on RV Bjarni Sæmundsson in May 2007, the zooplankton density was near and above the long-term mean off the south-, west-, and north coast while the density was below the mean off the east coast (Figure 2). As expected, *Calanus finmarchicus* was numerous in most samples and larger and slow growing arctic species in most abundant in the samples furthest off the north-east coast. Generally, the zooplankton density is less than in the year before (2006; ICES 2006).

### ***Blue whiting***

Practically no blue whiting were recorded west of Iceland. However, after having passed the Reykjanes Ridge (23°W) blue whiting were recorded in a narrow area along the shelf break south of Iceland and east of there in an area covered by the survey, i.e. between about 62°30' and 64°30'N, east to 09°W (Figure 3). The amount of blue whiting west of 15°W was though much less than in previous year (2006; ICES 2006). No blue whiting was observed north of 64°12' in this survey.

South of Iceland and west of 15°W there was a dominance of one year olds (year class 2006; 24% by biomass) as well as three (27%) and four years old (28%) but the total estimated biomass in that area was only around 100 thousands (Tables 2). Further east (E of 15°W and including Faroese waters) there were mainly older fish which in the southernmost part included post spawners migrating north.

### Herring

The herring distribution in the area covered in A08-2007 was more westerly and southerly than it has been since the collapse of the stock in the 1960s (Figure 4). Herring was observed more or less continuously from north of 64°11'N and east of 12°45'W (Hvalbakshalli) to 65°30'N and 06°W. At the 65°42'N transect, herring was limited to the eastern- and the western most parts but absent in between in the cold East Icelandic Current. Between 66°N and 68°N, the herring distribution was further limited to west by the cold arctic water but reached at least east to around 06°W.

Normally the herring was observed in many small schools, but considerable large schools were also observed, as for example in the cold front of the East Icelandic Current at around 300 m depth in temperature around 0°C (65°10'N and 09°38'W). There seems to be limited relation between the density distribution of the herring and zooplankton (Figure 5).

The total abundance estimate came to about 2.4 million tons, as detailed in Table 3. Of the total  $8.5 \times 10^9$  individuals in the acoustic estimation, around 75% of them were at length 33 cm (Table 4a). The most numerous year classes were those from 1998 and 1999, and they contributed to 61% of the herring abundance estimate (Table 4b). The age distribution was rather uniform in the area covered in the survey, it was mainly in the NE part (68°N and 6°W) that smaller and younger herring was found.

### Discussion

The results from the salinity and the temperature measurements in A8-2007, as well as the results from the annual spring survey aimed to record the hydrographic and environmental conditions in Icelandic waters (May survey on RV Bjarni Sæmundsson), indicate that the hydrographic conditions of Icelandic waters in 2007 are fairly mild and close to the long-term mean. Noteworthy, is that the temperature and the salinity off the east coast are though somewhat near or below the long-term-mean while the salinity in the East Icelandic Current (EIC) was above average.

As stated above, the distribution of the herring is much more southerly and westerly than in previous years and it needs to go back to the 1960s to find a resemblance. If that is a sign of reappearing of the stock on the old traditional feeding grounds off north Iceland is too early to state. On the basis of the oceanographic data that were collected in this cruise, we are not able to tell why the pattern of the feeding migration is changing in this particular summer. However, this has been expected to happen sooner or later with increasing size of the stock. It is not a surprise that it is mainly older herring that appears in the Icelandic waters as they are generally observed in the front of migrating herring beside that the 1998 and 1999 year classes (now at age 9 and 8) are obviously still numerous in the stock.

Because of the observation of more southerly and westerly feeding migration of the herring stock than in the last four decades, it is important to put more force and resources than has been in recent years to monitoring the stock's migration and distribution. That will be one of our issues in the upcoming months.

The herring showed generally stressful behaviour and avoidance to the approaching vessel and in comparison to sonar records there is little doubt that their abundance was underestimated. The degree of underestimation is, however, impossible to judge. The Icelandic assessment was conducted under excellent weather conditions for most of the survey with no retardation.

**References:**

ICES 2006. Report of the Planning Group on Northeast Atlantic Pelagic Ecosystem Surveys (PGNAPES). ICES CM2005/RMC:08: 91 pp.

**Table 1.** The number of samples in survey A08-2007 for the different fish species and how they were treated onboard.

Species	Counted	N length determined	N aged	N maturation determination	N weighed	Catch (tons)
<b>Blue whiting</b>	6967	1974	1789	1787	1787	30.65
<b>Herring</b>	0	5355	1789	1788	1789	104.23
<b>Mackerel</b>	0	326	220	220	220	0.93
Cod	0	2	0	0	0	
Haddock	0	47	0	0	0	
Saith	314	594	0	0	0	
Red fish	0	1	0	0	0	
Icelandic herring	1363	1232	0	0	0	
Capelin	0	206	205	3	205	0.01
Lumpsucker	0	2	0	2	0	
Deep sea red fish	0	1	1	1	1	
Slétti langhali (Coryphaenoides rupestris)	0	1	0	1	1	
Gulllax (Argentina silus)	0	17	0	0	0	
Laxsild ógr. (Myctophidae sp.)	0	49	0	0	0	
Urrari (Eutrigla gurnardus)	0	1	0	0	0	
Álsnipa (Nemichthys scolopaceus)	0	3	1	0	0	
Norræni silfurfiskur (Argyroleucus olferi)	0	1	0	0	0	
Slóans-gelgja (Chauliodus sloani)	0	2	0	0	0	
Vogmær (Trachipterus arcticus)	0	36	0	0	0	
Gjölur (Alepocephalus bairdii)	0	1	1	0	0	
Marangi (Holtbyrnia macrops)	0	1	0	0	0	
Geirsili ógr. (Paralepididae sp.)	0	6	0	0	0	
Silfurbrami (Pterycombus brama)	0	1	1	0	0	
Stóra sænål (Entelurus aequoraues)	0	9	0	0	0	
Beitusmökkur (Todarodes sagittatus)	0	1	0	0	0	
<b>Total</b>	<b>8644</b>	<b>9869</b>	<b>4007</b>	<b>3802</b>	<b>4003</b>	<b>0</b>

**Table 2.** Age- and length stratified abundance estimates of blue whiting in number and weight in the Dohrn Bank area and at the west and the south coast of Iceland between 30°W and 15°W in May 2007.

Length	Weight (g)	N Age									Numbers	Biomass (t)	Total
		1	2	3	4	5	6	7	8	9			
18	33.80	27834									27834	941	
19	40.38	118182									118182	4772	
20	46.04	174139									174139	8018	
21	52.86	146141	6958.48								153100	8093	
22	61.84	34355	2798.06								37153	2297	
23	73.58	8552	4824.95	8978							22356	1645	
24	85.52	4352	4039.44	13803							22194	1898	
25	97.48	2949		65513	4039	2020					74521	7264	
26	106.30			108064	10249						118313	12576	
27	116.37			75624	32627	2949	2020				113220	13175	
28	125.50				94313						94313	11836	
29	141.00			2020	55535	10916					68471	9654	
30	158.47				15650	6836					22486	3563	
31	171.34				13654	16914	10556				41124	7046	
32	211.22					6258	12423			7607	26289	5553	
33	222.72						21832	1403			23235	5175	
34	67.84						8134				8134	552	
35											0	0	
36											0	0	
37	323.60							3344			3344	1082	
38	348.45									3309	3309	1153	
Total N ('000)		516504.0	18620.9	274002.0	226067.8	45892.3	54965.7	4746.5	0.0	10916.2	1151715.6		
Total B ('000 t)		24869	1241	28799	29766	7382	10082	1394	0	2760		106294	
Average L (cm)		20.2	22.3	25.9	28.3	30.0	32.3	35.8		33.8			24.3
Average W (gr)		48.1	66.7	105.1	131.7	160.9	183.4	293.8		252.8			92.3
% N		44.8	1.6	23.8	19.6	4.0	4.8	0.4	0.0	0.9			100.0
Condition(g/dm <sup>3</sup> )		5.8	6.0	6.1	5.8	6.0	5.4	6.4		6.5			5.8

**Table 3.** Overview of the acoustic measurements of herring in A08-2007 for different areas.

Area	Herring tow samples	SA-value	N (millions)	Biomass (10 <sup>3</sup> tons)
Icelandic waters	14	9940	8284	2340.7
Faroe Isl. waters	2	206	193	50.8
Jan Mayen waters	1	114	95	22.6
Total	17	10260	8572	2414.1

**Table 4.** The acoustic estimation of herring in A08-2007 for (a) the different length groups and (b) the different age groups.

<b>a.</b>			<b>b.</b>		
Length (cm)	Total number (millions)	Biomass (10 <sup>3</sup> tons)	Age (years)	Total number (millions)	Biomass (10 <sup>3</sup> tons)
23	1.4	0.1	<4	3.5	464.1
24	0.0	0	4	64	13097
25	0.0	0	5	1249	281583
26	0.0	0	6	195	49009
27	2.1	0.3	7	619	166479
28	18.6	3.2	8	2802	792000
29	134.4	26.4	9	2423	708262
30	405.2	83.5	10	211	65411
31	540.0	121.2	11	141	44457
32	1048.8	263.3	12	126	41631
33	1843.0	498.9	13	101	34446
34	2356.0	685.0	14	304	101793
35	1195.4	375.5	15	294	101474
36	713.4	241.8	16	26	9221
37	239.5	86.5	17	13	4554
38	66.1	25.1			
39	7.5	3.1			
40	0.4	0.2			
Total	8571.8	2414.1	Total	8571.8	2414.1



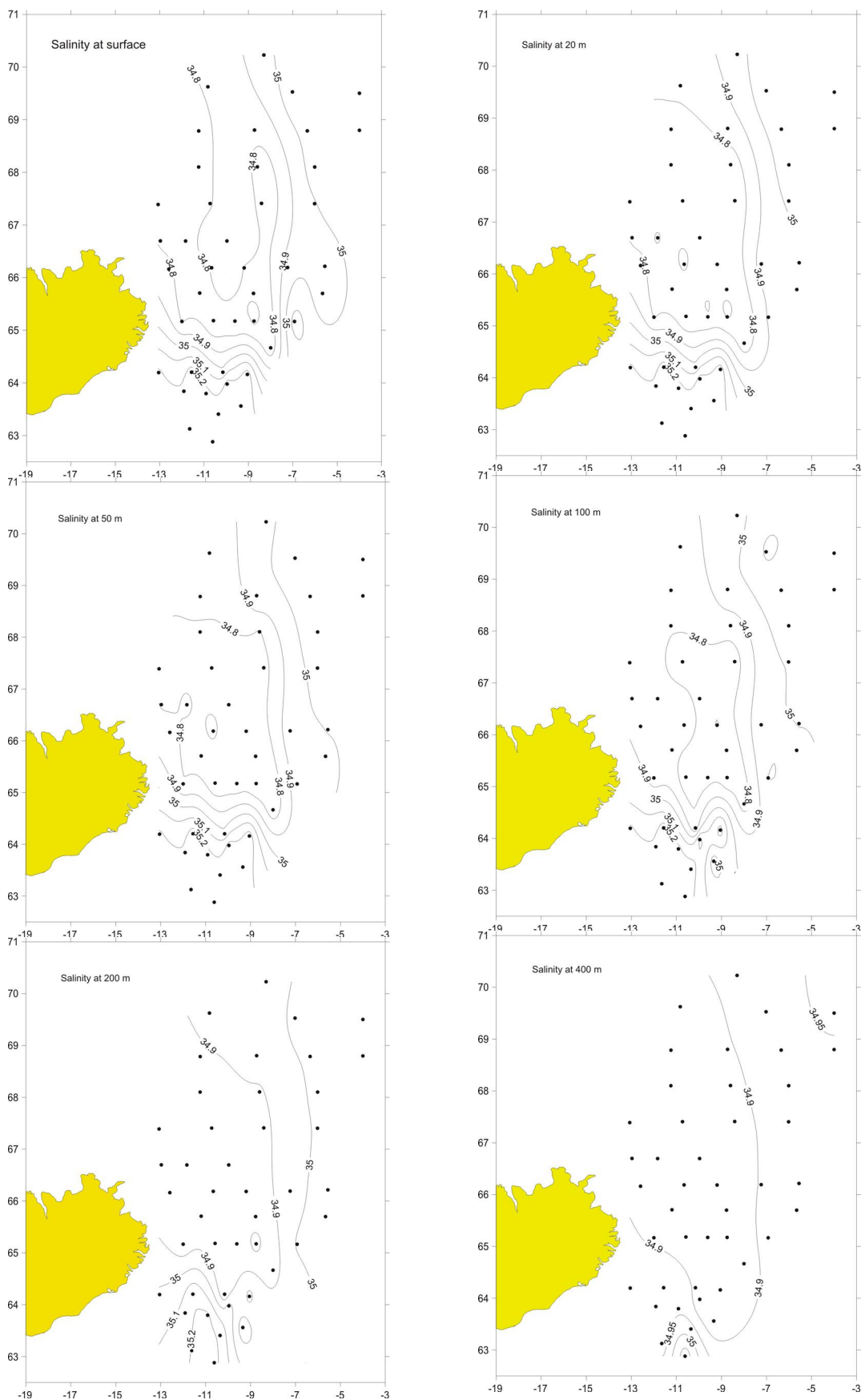


Figure 1. Salinity at surface, 20m, 50m, 100m, 200m and 400m as measured in A8-2007.

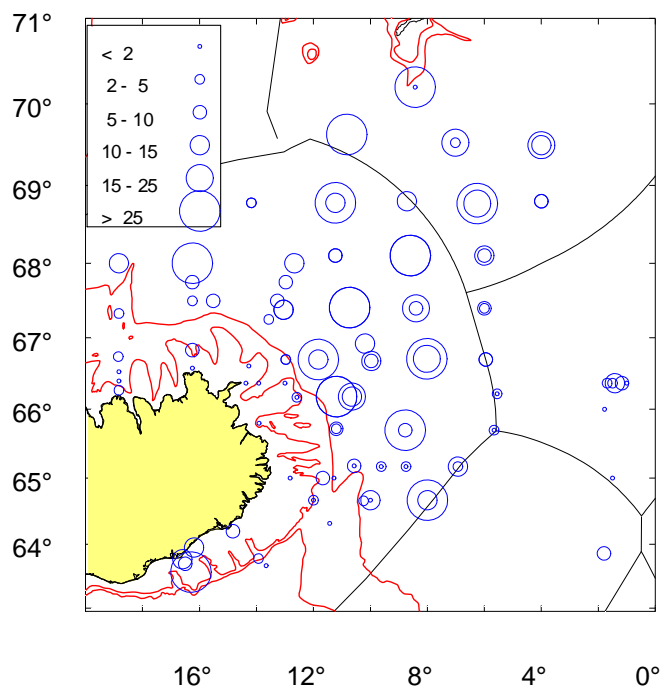


Figure 2. The relative density of zooplankton (converted to dry weight;  $\text{g m}^{-2}$ ) as recorded by Arni Fridriksson and Bjarni Saemundsson in May 2007.

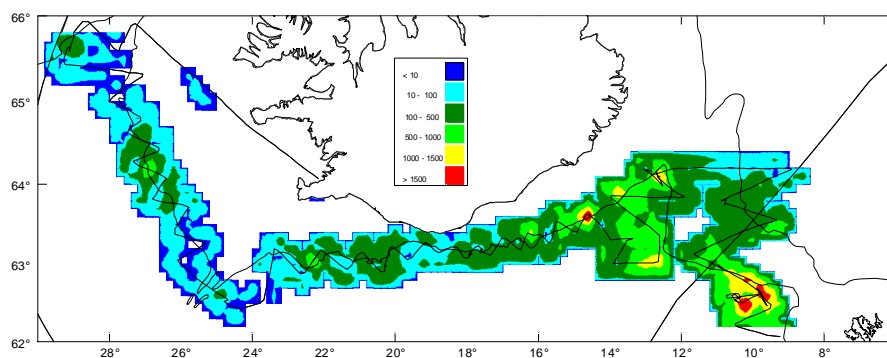


Figure 3. The relative density of blue whiting (Sa values) west and south of Iceland and between SE-Iceland and the Faroes in May 2007.

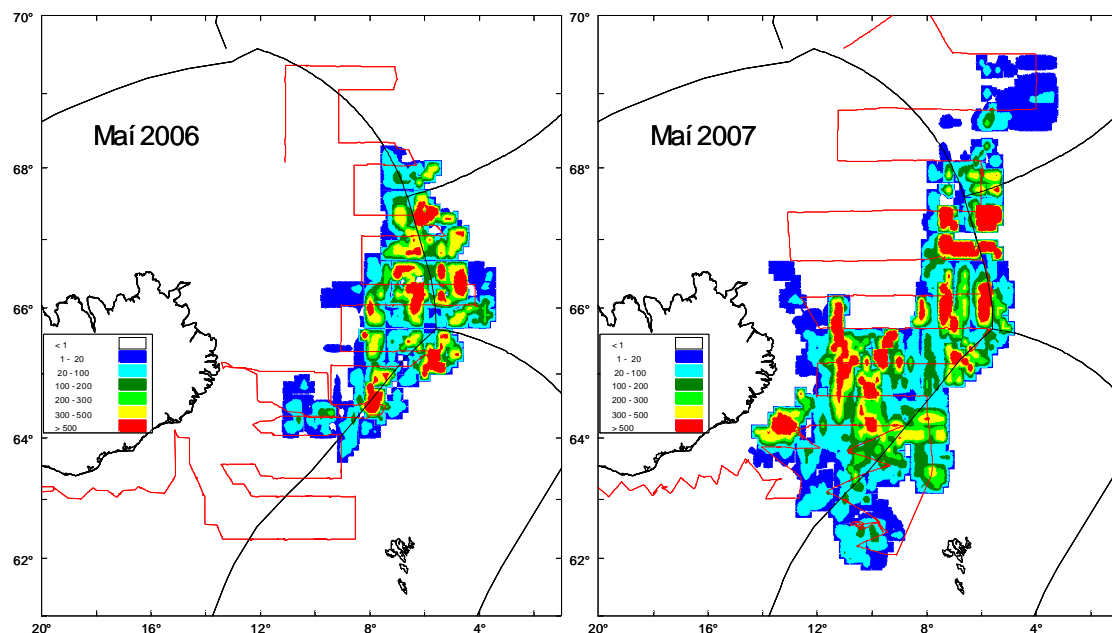


Figure 4. SA-values for Norwegian spring-spawning herring in May survey 2006 (to left) and now in May 2007 (to right).

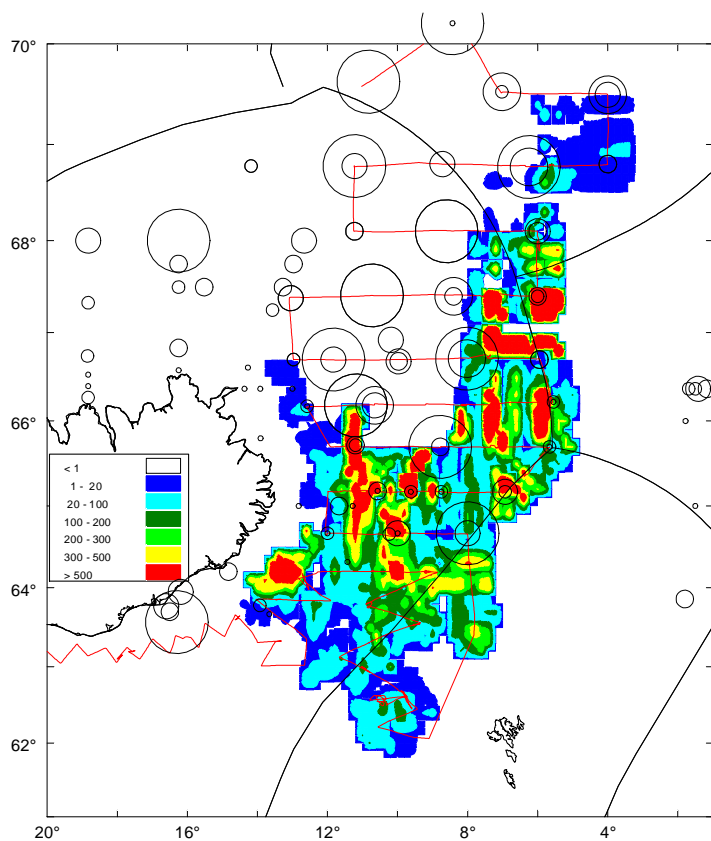


Figure 5. SA-values for Norwegian spring-spawning herring in May survey 2007 (contour) and the zooplankton abundance (bubbles;  $\text{ml} \cdot \text{m}^{-2}$ ) in the upper most 50 m (see scale for zooplankton on Fig. 2).